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ABSTRACT

To improve long-range vocational education planning in Maine, this study examined and evaluated the feasibility of replacing the manpower approach to planning with an investment approach. A survey of machinists was conducted to develop an instrument for measuring program benefits as part of the investment approach to program evaluation and planning. The investment approach proved to be valuable both in long-range planning and as an "in-house" planning and evaluation procedure for on-going programs. (BH)

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INVESTMENT PLANNING IN VOCATIONAL - TECHNICAL EDUCATION

A Pilot Study

Prepared by

JAMES A. WILSON DAVID F. WIHRY

MANPOWER RESEARCH PROJECT
THE UNIVERSITY OF MAINE AT ORONO

Under Contract With
THE BUREAU OF VOCATIONAL EDUCATION
MAINE STATE DEPARTMENT OF EDUCATION
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The authors assume responsibility for any remaining errors.

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INTRODUCTION

The study described in this Report was carried out between July 1970 and January 1971, by the Manpower Research Project at the University of Maine, Orono, under contract with the Bureau of Vocational Education, Maine State Department of Education.

Steps taken in the course of the study were:

1. familiarization of the Manpower Research Project staff with the problems of decision-making and long-range planning in vocational education,
2. familiarization of the staff with the machinist training program at Central Maine Vocational-Technical Institute,
3. design of a questionnaire to be administered to a sample of persons working as machinists,
4. administration of the questionnaire to 126 respondents, and
5. analysis of questionnaire responses in light of the goals of the study.

Statement of Purpose

The research upon which this Report is based was undertaken with the ultimate aim of enhancing the effectiveness of long-range vocational education planning in Maine.

More proximately, the study was designed to examine and evaluate the possibility of using an investment approach to planning in place of the manpower approach currently in use. The potential value of such an examination rests in the peculiar nature of vocational education as one of the few areas of government activity in which returns to expenditures can be measured, for the most part, in money terms. Due to the nearly unique measurability of vocational education output, decision-making in the area would seem to lend itself readily to the use of quantitative decision models aimed at efficient utilization of available resources. On the Federal level, quantitative decision models of this type are referred to as planning, programming, and budgeting systems (PPB). The investment approach constitutes one such model; the feasibility of implementing the investment approach for Vocational-Technical Institute planning is the subject of this Report.

Outline

The Report is divided into the following sections:

I. An examination of the educational planning problems of measuring manpower "needs" and comparing the effectiveness of various programs for meeting those needs.

II. A description of the "pure" investment approach to educational decision making.

III. An examination of the problems involved in measuring the costs and benefits of education.

IV. An introduction to the survey method of measuring vocational education benefits.

V. A description of the survey of machinists carried out by the Manpower Research Project and an evaluation of the survey's usefulness.

VI. Analysis of the characteristics of Maine machinists.

VII. An examination of the feasibility of the investment approach as a tool for Vocational-Technical Institute planning and program evaluation, with suggestions for modifying the approach for practical application.

I. THE VOCATIONAL EDUCATION PLANNING PROBLEM

Statement of the Problem

The method of treating education as an investment can be described best in terms of a typical problem faced by an educational planner. There are a great many combinations of students and programs which a planner may choose in designing the overall mix of educational expenditures. The budget available to the planner limits the total number of programs possible and the total number of students who may be served.

The planner must have at his disposal a method for evaluating the worth of the many alternatives with which he is faced in order to select rationally a combination of alternative programs which maximizes for society and for the student the value resulting from expenditures on education.

The planning procedure needed to arrive at an efficient combination of programs may be divided into three stages:

1. listing feasible alternative programs given administrative and legal constraints,
2. establishing the net benefits of each feasible program alternative at each program level, and
3. choosing a combination of alternative program levels in such a way as to maximize the value resulting from the given total budget.

Choice of Criterion

Steps 2 and 3 presuppose that a criterion for establishing the value of each alternative and of the overall budget has been decided upon. Such a criterion is necessary in order to make the outputs of various alternative training programs commensurable. There are a number of possibilities.

The criterion used in the manpower requirements approach, the method on which the State Vocational Education plan is currently based, is the "need" of the state or national economy for individuals to fill various job categories. Other criteria frequently used include the proportion of graduates finding jobs requiring the skills in which they were trained, the average starting wage of graduates, and the success with which a school is able to fill immediate requests from specific firms.

Such criteria, however, are vaguely defined, immeasurable, or consider only the benefits accruing to a single individual, firm or industry. They provide no guide or standard for the direct comparison of one program with feasible alternatives.

For example, the "manpower needs" criterion as currently implemented requires the projection of job vacancies within the State or relevant planning area over a period of several years. Since data necessary for these projections are not available*

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*Except for the nation as a whole, and then they are very unreliable. See Appendix A for more detail.

or too costly to generate, the criterion becomes operationally immeasurable and planning based on the approach becomes infeasible.

Other criteria frequently used have equally fatal problems. For example, if the number of graduates placed in jobs for which they were trained is the criterion used, the difficult but important question of whether alternative programs might not have placed more graduates at a lower or equal cost to the school, or at higher wages for the students, is not even broached. Nor could this criterion provide a reasonable guide for answering this question. Similarly, a criterion such as success in "filling the orders" of specific firms does not begin to ask whether alternative uses of the educational institution's resources might have been more beneficial to society, to students, or to other firms.

The investment approach, on the other hand, utilizes a criterion of value which allows direct comparisons of benefits and costs of alternative programs and quantification of the total output of the planned budget mix. This criterion is the estimated difference between total benefits and total costs, or alternatively, the present value of the net benefits attributable to each program. Calculation of the present value of the net benefits to society and the student from each possible training program permits effectiveness comparisons, and at the same time provides an index of manpower needs and job opportunities.

II. THE INVESTMENT APPROACH

Manpower needs are estimated in the investment approach by utilizing signals provided by the labor market. Industry reveals its manpower requirements through the market in the following way. If for some reason a shortage develops in the supply of individuals trained in skill A, firms will bid against one another to obtain the individuals available. As a consequence, wage rates in occupation A will rise. Conversely, if a surplus develops in the supply of individuals with skill B, there will be no tendency for wages in that occupation to increase. Assuming that the training costs for both skills remain constant, the net value of training in skill A will rise relative to that for skill B. That is to say, the difference between costs of training and the present value of future income in the former job category will tend to rise relative to that in the latter job category.

If the "educational market" responded to market signals fluidly, more individuals would enter occupation A and fewer would enter occupation B, each potential employee calculating which occupation would be to his best advantage. Eventually, due to increases in the supply of persons with skill A, the net value of training in skill A would begin to fall relative to the net value of training in skill B.

However, the response of the "educational market" is not especially fluid or "normal" since the decision-making involved is

removed, in part, from the control of the primary beneficiary, the trainee. Decision-makers in the educational market include not only trainees, but also those charged with properly allocating public expenditures on (or investment in) job training. The investment approach makes available to public decision-makers information which allows them to simulate the quality of "normal" market decisions where each individual calculates the costs and returns to him of his educational investment and acts accordingly.

The Decision Model

Putting aside for the moment the measurement problems to be described below, a simple hypothetical example may be used to illustrate the use of the investment approach in making training program comparisons aimed at approximating market results. Assume that the per student cost of training in each skill is the same: $20,000 (including $12,000 foregone earnings) for a two-year program of training in each skill.* Assume also that the present value of future income accruing to an individual with skill A is expected to be $125,000 and that to an individual with skill B $100,000. If a student could earn income with a present value of $90,000 without vocational training, the increase in lifetime

*$4,000 direct costs for the student and public each year and $6,000 foregone earnings each year.

earnings attributable to training in A is $35,000 and that attributable to B is $10,000. Since the cost of training in both skills is $20,000, training in A yields a net gain to society and to the student of $15,000 whereas training in skill B yields a net loss to society and to the student of $10,000. Clearly, training additional students in skill A is preferable.*

Hypothetical Decision Problem

	Skill A	Skill B
Present value of lifetime earnings with voc.-tech. training	$125,000	$100,000
minus present value of earnings without training	90,000	90,000
Present value of net benefit stream	35,000	10,000
minus cost of training	20,000	20,000
Net gain (+) or loss (-)	+15,000	-10,000

Actual implementation of the investment approach is not as simple as this idealized model suggests. The most obvious difficulties have to do with accurately measuring the costs and benefits which constitute the data on which decisions are to be based.

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*This hypothetical example assumes that students are indifferent between occupations A and B. Situations in which this is not the case are discussed in Section VII.

III. BENEFITS AND COSTS OF EDUCATION

For decision-making and planning purposes comparisons of the net value of training in various occupations require the measurement of costs and benefits associated with each training program.

Nature of Benefits

For each of the program alternatives faced by the planner there are distinct types of benefits expected to accrue to society and to students.

Private benefits--returns accruing to the student--include both monetary and non-monetary elements. The primary monetary benefit is the value of the income a student receives above that which he would have received had he not undertaken training.

Among the non-monetary benefits a student may receive from training are the opportunity for further (perhaps on-the-job) training, intergenerational benefits accruing to his children, and personal job satisfaction.

Social benefits are likely to be identical with private benefits unless the education or training provides a student with some attributes which benefit the rest of society without society having to fully pay for these attributes. Better citizenship is frequently cited as a "spill-over" benefit from general education.

Nature of Costs

Costs, likewise, may be social or private in nature.

Private costs--Costs incurred by the student include tuition, fees, supplies, etc., and foregone earnings.

Foregone earnings are defined as the amount of income a student must give up as a result of becoming a student. That is, foregone earnings include the income a student could earn were he not attending school, less the amount he earns through part-time work while a student.

Estimates for post-high school education in the United States indicate that foregone earnings are likely to represent between 60 percent and 70 percent of the total costs of education.*

Social costs include all private costs plus the value of public subsidies to the student's training.

Measurement Problems Associated With the Pure Investment Approach

Specific measurement problems are associated with each category of costs and benefits.

Costs

Problems of determining the costs of a training program generally arise because of inadequate and dissimilar accounting

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*T.W. Schultz, The Economic Value of Education, Columbia University Press (New York, 1963), p. 29.

systems. Measuring costs of alternative programs at an educational institution or among a number of institutions requires uniformity and precision, a combination of standards which is difficult to achieve. Further difficulties arise because it is necessary to know both how a program's costs vary with expansion and contraction of variable inputs, faculty and students, when plant and equipment is fixed, and how they vary with long-run changes in physical plant.

Estimation of costs arising from students' foregone earnings also poses difficulties. It is not always easy in specific cases to say exactly how much a student might earn were he not participating in a training program.

Benefits

The measurement of benefits presents several difficult conceptual and empirical problems which--as will be pointed out in detail below--may be "finessed" when dealing with vocational education programs.

Problems associated with estimating benefits that accrue to a student over his lifetime as a result of training include:

1. lack of perfect foresight regarding a student's future income and the temporal pattern in which it will accrue to him,
2. the difficulty of ascribing extra income trainees obtain in later life solely to the training they receive as opposed to other characteristics such as the student's previous training, intelligence, motivation, etc.,

3. the problem of comparing and aggregating income received at widely different times in the student's lifetime.

On the non-monetary side the measurement problems are more difficult. Quantification of such things as opportunities for further training, intergenerational benefits, and increased personal satisfaction is almost impossible. Under certain conditions, however, there is no need to attempt measurement of these factors.

IV. MEASURING BENEFITS AND COSTS IN VOCATIONAL EDUCATION: SURVEY DESIGN

Fortunately, the relative homogeneity of the student group participating in two-year post-high school vocational-technical programs limits the magnitude and severity of measurement problems. This is perhaps explained best by detailing the methods which would be used in a full-scale evaluation of the costs and benefits of vocational-technical education programs.

Measuring Benefits from Vocational-Technical Training

First, the concern is to measure only the relative benefits and costs of the two-year vocational-technical training programs. The desired comparison is among various vocational-technical training programs, not between either vocational-technical training and other types of post-secondary education such as general education at the college level or between vocational-technical training and no post-secondary training at all. This means that, on the benefits side, it is only necessary to compare the non-monetary benefits received from, for example, a course in machine tool technology, with those received from a course in sheet metal work. It is not necessary to compare the non-monetary benefits from machine tool training with the alternative of no training at all at the post-secondary level or with the alternative

of a four-year college course. Since non-monetary benefits are likely to vary only slightly from course to course within vocational training curricula, if in fact they vary at all, there is likely to be very little bias introduced by ignoring the non-monetary benefits.

In comparisons restricted to various types of vocational-technical training it is also less important to isolate the effects on income of differences in the personal backgrounds and capabilities of students. While such differences among vocational-technical students in various training programs may be great, they are certainly less than differences between vocational-technical trainees as a group and college students as a group. In effect, then, measurement problems on the benefits side reduce to those associated with estimating the present value of students' incomes.

The Survey Method

Estimating the present value of future income generated by training in a given occupation requires knowledge of the occupation's age-income profile. This study uses cross-sectional analysis to determine the shape of that profile for machinists.

Cross-sectional surveys take advantage of the fact that age-income profiles are likely to retain their shape even when the average wage in a particular occupation varies over time. For example, the estimated age-income profile for a particular occupation may indicate that an individual now starting at $7,000

per year will be earning $10,500 per year ten years from now. The one and one-half to one ratio between income in the tenth year after training and starting salary is likely to be maintained even though starting salaries themselves may increase through time. In other words, while the age-income profile for one occupation may shift up or down relative to others, its shape is likely to remain fairly stable. The practical consequence of this apparent phenomenon is that starting salaries may be inserted into age-income profiles derived cross-sectionally in order to estimate incomes accruing each year into the future. However, since age-income profiles may differ in shape--i.e., in the bunching of income nearer to or further from the present--a full scale cost-benefit analysis of vocational-technical training programs for planning purposes would require cross-sectional estimates of age-income profiles for each training program within the mandate of the planning agency.

Survey Refinements

Cross-sectional surveys of age-income relationships in each type of skill can be designed to further refine the basic information described above. The need for refinement arises from the fact that many persons who receive technical school training in one skill may eventually move into higher-paying management or supervisory positions. If the probability of upward mobility out of a specific job classification differs from one type of skill to another, the expected present value of future income for

occupations yielding higher rates of upward job mobility will be understated.

To avoid understating future income in cases of relatively high vertical job mobility, the test questionnaire used in this survey asks for job histories. Though little work has been done on this question by other investigators, it would be expected that discernible patterns of inter-occupational movement would be revealed by job histories.

The Present Value of Future Income

Another problem associated with measuring the benefits of a particular training program concerns the aggregation of income received at different points in the student's working life. People's preference for income now rather than later is recognized by the fact that interest must be paid to induce people to lend and thereby postpone consumption. The market rate of interest reflects society's time preference for income and may be used to reduce to present value projected levels of income. If B is equal to income accruing in year t, then the present value of that income, Y_p, is given by the formula

$$Y_p = \frac{Bt}{(1+r)t}$$

where r is the rate of interest. The discounting procedure is important to the extent that the shape of age-income profiles differs among occupations. If projected income peaks sooner in one occupation than in the other, even though the monetary value of lifetime earnings may be the same in both, the former

occupation will have a higher present value and, given the cost of training in each, should be ranked relatively higher than the latter on the cost-benefit scale.

Measuring the Costs of Vocational Training

On the cost side, the basic information required by the investment approach is cost per student for each possible training program.

Direct program costs appear to involve no special measurement problems other than the collection of data from each Institute on a consistent and comparable basis. Foregone earnings may be estimated by averages based on the previous earnings experience of new students or on the current earnings of persons with similar socio-economic characteristics.

Since cost measurement presents no conceptual problems, the emphasis of this study is primarily on the problems of benefit estimations.

Finally, as noted above, measurement of net gains from any educational program requires subtraction of the present value of earnings in alternative occupations not requiring vocational-technical training. However, vocational-technical program decisions at the state level do not require this information. Concern is with the relative benefits of various training programs and not with the relative benefits of vocational training as opposed to other types of training or no training at all. The latter

comparison is assumed to have been made at the level of the funding agency and the total budget allocation to the operating agency at the state level is assumed to reflect a presumption or determination that net benefits from any form of vocational training within the scope of the Vocational-Technical Institute's mandate are positive. Furthermore, the relative homogeneity of potential vocational-technical trainees, as noted above, lends credence to an assumption that lifetime earnings will be roughly similar in the absence of training, or at least that deviations from the average are not likely to be great.

V. THE MACHINIST SURVEY

Survey Design

A test survey of machinists was conducted in the summer of 1970 for the purpose of developing a data instrument to elicit the information on program benefits required by the investment approach in the evaluation and planning of vocational-technical school offerings. It was felt that if the problems of obtaining meaningful data on lifetime earnings and occupational mobility could be solved for a single occupation, the procedure could be applied with minor modifications to all programs offered at the Vocational-Technical Institutes.

Two interviewers administered a survey questionnaire to 126 men either currently employed as machinists or promoted from machinists' jobs to supervisory or management positions. Since job history information was asked, the questionnaire provided data on 483 jobs, past and current.

The geographic area covered by the survey included Biddeford, Saco, Portland, South Brunswick, Lewiston-Auburn, and Bangor. Interviewees worked for firms which ranged in size from one to more than 1,000 employees.

The questionnaire used in the survey (See Appendix B) provided extensive information on past and present jobs, job training experience and wages. Up to five job histories were compiled

TABLE 1

FREQUENCY OF INTERVIEWS BY FIRM SIZE

Firm Size*	Number of Observations
less than 20	71
20 to 50	24
51 to 100	35
101 to 250	21
greater than 250	95

*Total employees

in each interview, covering subjects including name of employer, length of employment, job title, job description, income, training, and past and present residence. General information questions asked for age, marital status, number of dependents, wife's occupation, and an indicator of mobility.

In the design of the questionnaire special care was taken to obtain accurate job descriptions in order to distinguish adequately among the many types of machinists working in the market. Since the Vocational-Technical Institutes train what are referred to as first class machinists--occupational classification number 600 in the Dictionary of Occupational Titles (DOT)--, a serious understatement of the value of Vocational-Technical Institute training would be obtained from calculations based on a sample including those less skilled members of the work force who, for one reason

or another, call themselves machinists. The survey was designed to deal with this problem in two ways. First, the interviewee was asked his job title. This simple question often provided a sufficiently accurate response. As a check, however, the interviewee was then asked what types of machines he worked with and what operations he performed with these machines. The second precaution taken involved a short course in machinist job descriptions given to project members by the staff of Central Maine Vocational-Technical Institute. Interviewers used background information from this course and the detailed job descriptions yielded by the questionnaire to classify interviewees by DOT job classification. One hundred and fifty-nine job histories of persons fitting 600 DOT classification were obtained in this way.

Evaluation of the Survey

For the purposes of this study a good questionnaire is one which makes it possible to isolate from among the many types of machinists in the market those whose job characteristics place them in the first class machinist's category.

Operationally, this was taken to mean machinists included in the 600 DOT job classification. Table 2 shows the frequency distribution of those machinists interviewed by wage level and by age. The sample of 600 DOT machinists was compared statistically with the sub-set of Vocational-Technical Institute graduates within

that group to determine if the two populations from which the samples were drawn were significantly alike. The age-income frequency distribution of Vocational-Technical Institute graduates is shown in Table 3. Our reason for making this comparison was that, if the two populations were found not to differ significantly, it would be safe to conclude that a survey which interviewed 600 DOT machinists, irrespective of whether they had Vocational-Technical Institute training, would provide adequate measures of the expected income of Vocational-Technical Institute graduates alone.

This question was evaluated in two separate ways. In the first method, stepwise multiple linear regression was used on a sample of 150 first class machinists.* A curve of the following form was fitted to the data,

$$(1) \quad Y = a + bA + cA^2 + e,$$

where Y = income, A = age, and a, b, and c are the parameters of the equation. Then, to determine if formal Vocational-Technical Institute training made a difference, an additional regression of the following form was run:

$$(2) \quad Y = a + bA + cA^2 + dVTI + e,$$

where VTI is a dummy variable indicating attendance or non-attendance at a two-year Vocational-Technical Institute. It was found that equation (2) did not improve (or change) the degree to which income of 600 DOT machinists could be predicted, relative to

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*These observations included both current and past jobs.

TABLE 2

THE AGE AND INCOME OF FIRST CLASS
(600 DOT) MAINE MACHINISTS

INCOME/AGE	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 +
0,000-2,999	1	0	0	0	0	0	0	0	0	0	0
3,000-3,999	1	0	0	2	1	1	0	0	0	0	0
4,000-4,999	1	3	1	2	3	2	2	0	0	0	0
5,000-5,999	1	11	9	3	3	4	1	3	3	0	1
6,000-6,999	0	8	5	2	3	2	6	3	4	3	1
7,000-7,999	0	2	7	0	0	5	5	3	4	2	0
8,000-8,999	0	2	3	3	1	1	2	2	1	1	0
9,000-9,999	0	0	3	1	0	1	1	1	0	0	0
10,000-10,999	0	1	1	2	1	0	1	1	0	0	1
11,000-11,999	0	0	0	0	0	0	0	0	0	0	0
12,000-12,999	0	0	0	0	0	0	0	0	0	0	0
13,000-13,999	0	0	0	1	1	0	0	0	0	0	0
14,000 +	0	0	1	0	0	1	0	0	0	0	0
AVERAGE INCOME	3830	6183	7199	6942	6524	6893	7073	7250	6717	6925	7533

TOTAL NUMBER OF OBSERVATIONS ARE 159

TABLE 3

THE AGE AND INCOME OF FIRST CLASS (600 DOT) MAINE MACHINISTS
WHO ARE VOCATIONAL-TECHNICAL INSTITUTE GRADUATES

INCOME/AGE	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 +
0,000-2,999	1	0	0	0	0	0	0	0	0	0	0
3,000-3,999	0	0	0	0	1	0	0	0	0	0	0
4,000-4,999	1	2	1	2	0	0	0	0	0	0	0
5,000-5,999	1	3	4	1	1	0	0	0	0	0	1
6,000-6,999	1	4	4	0	0	0	1	0	0	0	1
7,000-7,999	1	1	3	1	0	0	0	1	0	0	0
8,000-8,999	0	0	1	1	0	1	0	0	0	0	0
9,000-9,999	0	0	2	0	0	0	0	1	0	0	0
10,000-10,999	0	1	0	1	0	1	1	0	0	0	1
11,000-11,999	0	0	1	0	0	0	0	0	0	0	0
12,000-12,999	0	0	0	0	0	0	0	0	0	0	0
13,000-13,999	0	0	0	0	1	0	0	0	0	0	0
14,000 +	0	0	0	0	0	0	0	0	0	0	0
AVERAGE INCOME	5340	6161	7029	6718	7163	9000	8000	8150	0	0	7533

TOTAL NUMBER OF OBSERVATIONS ARE 50

equation (1). Hence, we tentatively concluded that the earnings experience of 600 DOT machinists represents the earnings experience of Vocational-Technical-trained machinists as well.

It should be noted, however, that within the 600 DOT classification and within the sub-set of Vocational-Technical Institute graduates there is a great deal of variation in income, and that statistical estimates such as those described above merely indicate that little or no variation in income is attributable to Vocational-Technical attendance. Put differently, the 600 DOT job classification population appears to have nearly the same characteristics as the population of machinists who attended Vocational-Technical Institutes. This similarity even extends to the variability of income.

As a second check that measures based on machinists as a group were applicable to the sub-set of Vocational-Technical-trained machinists, income profiles were estimated for the 600 DOT group and the Vocational-Technical Institute sub-group separately. For the 600 DOT group the estimated profile took the form:

$$(3) \quad Y = 4496.32 + 105.67A - 1.05A^2,$$

and that for the Vocational-Technical group took the form:

$$(4) \quad Y = 2170.29 + 230.99A - 2.18A^2$$

again, where A = age and Y = income. From the point of view of estimating the benefit stream of the Vocational-Technical Institute program it was of interest to know whether these estimated income profiles produced the same or approximately the same value of estimated benefits. On the assumption that a Vocational-Technical

Institute graduate begins work at age twenty and retires at age sixty-five, the present value of the income stream at 6 percent for the 600 DOT group was found to be $105,000. This was very close to the present value of the income stream for Vocational-Technical Institute graduates which was estimated to be $110,000.*

From visual observation of the estimated profiles (See Chart 1) it is apparent, however, that even though the 600 DOT group as a whole provides a reasonably good estimate of the present value of the income stream for Vocational-Technical Institute graduates, the characteristics of the two profiles differ somewhat. Specifically, Vocational-Technical Institute graduates seem to climb to higher peak incomes but do so at a somewhat later time than 600 DOT machinists as a whole. By and large, however, it appears that the surveyed population of 600 DOT machinists represents a fairly accurate picture of the income expectations associated with Vocational-Technical Institute machinist training.

Both of the above analyses lead to the conclusion that a survey procedure which (1) carefully defines the output of a Vocational-Technical Institute training program, and (2) surveys

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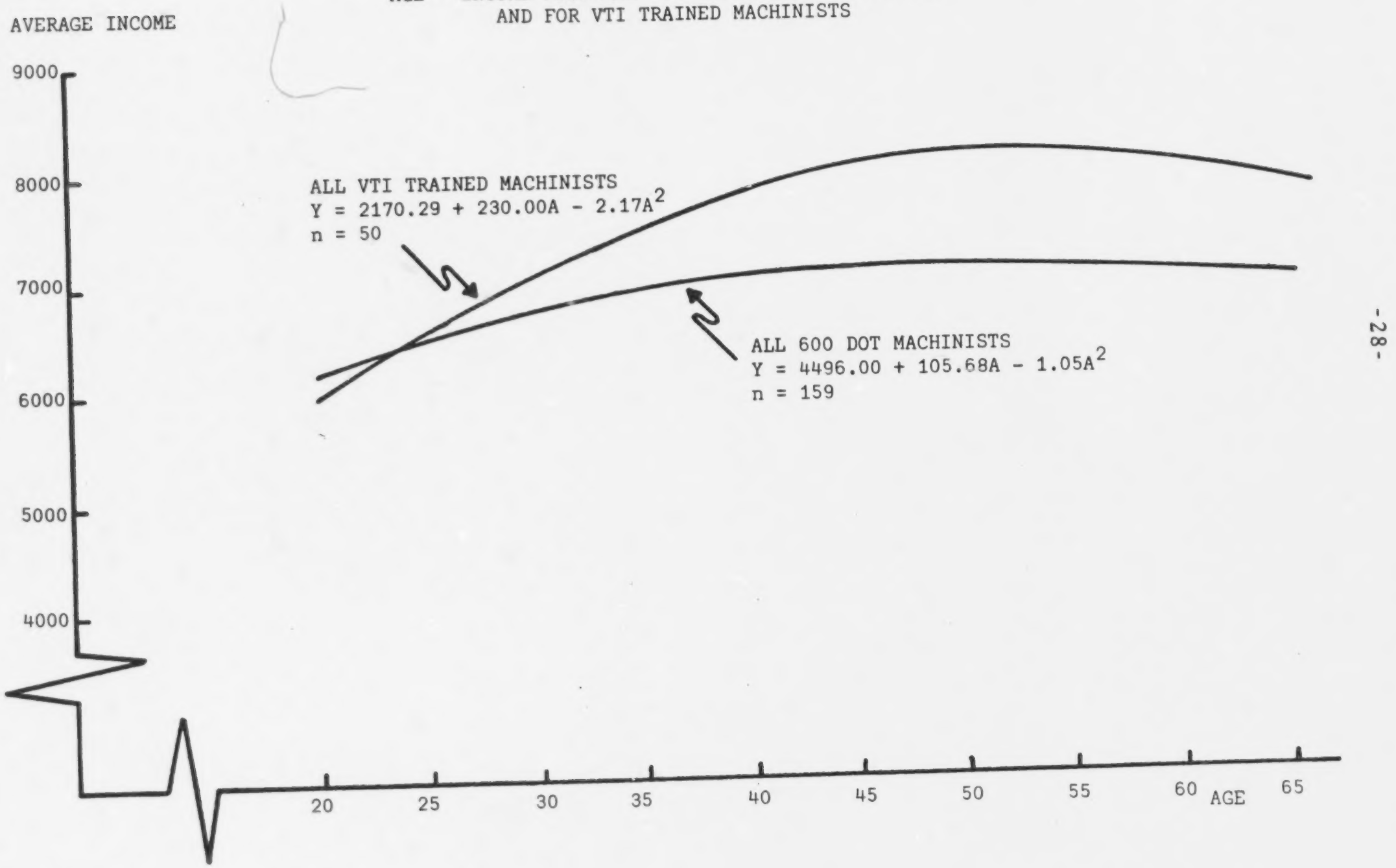
*It should be noted that the present value figures presented here do not represent the value of Vocational-Technical Institute machinists training programs. As emphasized above, in order to obtain such a figure it would be necessary to subtract from the above $110,000 estimate the costs of Vocational-Technical Institute training and the present value of the individual's lifetime income had he not attended a Vocational-Technical Institute. See pp. 8 and 9 above, for an hypothetical example.

CHART 1
AGE - INCOME PROFILES FOR ALL 600 DOT MACHINISTS
AND FOR VTI TRAINED MACHINISTS



only persons with the specified job characteristics is capable of producing a reliable estimate of the private benefits streams accruing from Vocational-Technical Institute training programs. This is likely to prove a reliable procedure even if the people interviewed did not graduate from a Vocational-Technical Institute training program.

VI. CHARACTERISTICS OF MAINE MACHINISTS

Firm Size and Income

Characteristics of first class machinists (600 DOT) revealed few surprises. One of the surprises that did come up, however, was the finding that there is no discernible difference in machinists' income attributable to the size of the firm for which they work. Table 4 shows present value summaries of income

TABLE 4

INCOME AND FIRM SIZE

Size of Firm	Present Value of Income*
less than 20	$104,000
20 to 50	107,000
50 to 100	104,000
100 to 250	105,000
Greater than 250	103,000

*Using an interest rate of 6%

expectations to be remarkably similar regardless of firm size. The small variation in present value estimates between smaller and larger firms is contrary to the expectation of the staff of the machine tool program at Central Maine Vocational-Technical Institute and of the Manpower Research Project staff prior to this study that firm size would be an important determinant of income variations.

The most appealing explanation of this phenomenon is one which is highly favorable to the proposition that labor markets work efficiently with respect to payment according to skill or proficiency. For example, the idea that large firms pay better for the same skills implies that they can afford and are willing to shift some of their profits to the workers. Hard-nosed economic theory, on the other hand, would lead one to expect no such shifting of profits in a competitive market. This is on the assumption that large and small firms alike are profit maximizers and are, therefore, willing to pay only the amount necessary to keep the required number of people of the required skills in their employment. As long as workers are free to move from job to job employers will find that they all wind up paying the same wages to persons of comparable skills and experience.

The initial expectations held by ourselves and the staff of Central Maine Vocational-Technical Institute can perhaps be best explained on the grounds that casual observation of wage variations by size of firm often does not take into explicit account variations in skill or experience actually used on the job. Though there are, undoubtedly, a great many individual exceptions to this finding, in a statistical investigation of this sort these exceptions tend to wash out. This finding, by the way, lends further support to the basic idea behind this study that the forces of supply and demand which determine wages in labor markets are the best indicators of the manpower needs of the economy.

Wage Trends for Machinists

In the survey, interviewees were asked about their previous jobs. One question asked for an estimate of the income they received from these jobs. As part of the analysis these income figures were inflated to comparable current levels by use of the Consumer Price Index (cost of living index) compiled by the Bureau of Labor Statistics.* There is no reason to suspect that this is a particularly valid procedure, since it is quite possible that machinists' incomes could rise or fall relative to the cost of living. Therefore, in order to test the validity of this "inflation" procedure we used regression analysis to determine whether or not the inclusion of historical data affected (either up or down) our estimates of machinists' incomes. The results of this analysis showed no discernible affect upon income, or to put it differently, that the Consumer Price Index was a reliable inflator. This also led us to the tentative conclusion that machinists' incomes have shown no discernible improvement nor deterioration with respect to changes in the cost of living index.

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*U.S. Department of Labor, Bureau of Labor Statistics, Consumer Prices and Price Indexes, Sept. 1971.

Formal Schooling and Other Training

Among the 600 DOT machinists interviewed some 49 percent reported no formal schooling or training programs beyond the high school level. Formal schooling or informal training programs directly related to machine tool technology were reported by 46 percent, while 5 percent reported formal schooling or training not related. The median number of years of formal school reported was 11.6 which is about one year above the national median for males in the work force. It should also be noted that most of the machinists with less than a high school education were in their late forties or older.

Informal on-the-job acquisition of skills seems to have played an important role in preparing interviewees for their current jobs. Approximately four-fifths of the interviewees stated that training provided on-the-job by either current or former employers was either the primary or secondary source of their skills. This is about four and one-half times the number that reported formal school training as either the primary or secondary source of their skills. When one considers the primary source of skills, however, the picture changes somewhat. Only three times as many respondents listed on-the-job training as opposed to formal school training as the primary source of their skills. In other words, even though a large majority of the machinists interviewed did not have formal school training in machine tool

technology, among those who did have formal school training, it was almost invariably listed as the primary source of their skills. Only three persons who participated in formal school training programs did not list that as the primary source of their skills.

Mobility and Training

Part of the job history information collected from each respondent related to how and where he received the training for each job. Two questions distinguished between on-the-job and formal training programs, and between training received from current and previous employers. These questions were asked because many economists working in the area of education and training claim that employers do not have an incentive to train, usually finding that other firms tend to "pirate" the (ex-)trainee.* The employer then finds that he has to begin the training process all over again with another person. After a few experiences of this sort, the employer is quite likely to interpret his actions as more nearly approximating those of a school for his competitors than those of an industrial enterprise. Consequently, he will curtail his training activities and become a "pirate" himself. With all employers behaving in this way there will be an increasing need for public provision of training programs.

By and large, the data gathered in this study supports this view of the relationship between employer-supported training and

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*G. Becker, Human Capital (National Bureau for Economic Research, New York, 1964), pp. 32-43.

labor mobility. For example, of those respondents who reported on-the-job training as the source of their current skills, 54 percent had acquired these skills from previous employers. This suggests a significant amount of mobility related to training programs.

The picture is much more distinct, however, with respect to formal training programs offered by employers. Since formal training programs are more costly to the employer tnan on-the-job training, one would expect, first of all, less reporting of formal training programs and, secondly, more mobility associated with these programs.

Both these expectations are borne out by the data. (See Table 5.) About three times as many on-the-job training programs were reported as were formal training programs. Significantly, of the respondents reporting formal training programs as the source of their current skills, 75 percent acquired these skills in programs offered by previous employers. This is a very high degree of mobility and lends strong support to the notion that employers who give or send trainees to formal training programs are quite likely to find many of the people they have trained leaving for employment with other firms. Consequently one would expect that firms are not likely to engage in a great number of these programs. Another implication, of course, is that a large part of the burden of formal acquisition of skills, at least among machinists, is shifted by industry to the public or, to a certain extent, to those firms willing to offer formal

training in spite of the high likelihood that their trainees will move to other firms. Put in slightly different words, if it is felt that a high level of skills in the economy is desirable, it would be a mistaken public policy to rely upon industry for the provision of these skills since the firms which must offer the training programs are likely to find it particularly unrewarding.

TABLE 5

TYPE AND SOURCE OF CURRENTLY USED SKILLS*

On-the-Job		Formal Program	
Current Employer	Previous Employer	Current Employer	Previous Employer
104	120	18	52

*Data in this table relates to all machinists not merely 600 DOT machinists.

VII. THE INVESTMENT APPROACH IN PRACTICE

The investment approach to decision-making in vocational-technical education is potentially useful in two related areas: (1) as a long-range planning and budget justification procedure which is in conformity with the requirements of the funding agency, and (2) as an "in-house" planning and evaluation procedure for on-going programs. Both uses of the approach require essentially the same information. In this section of the Report we describe the adjustments we feel would be necessary for a translation of the "pure" theoretical approach described in Section II into a practical policy tool. It will be shown that the investment approach meets the legally mandated planning procedures imposed on the State Board of Education--although these procedures are somewhat open to interpretation--and that information produced by surveys similar to the one described above may be translated into policy guidance for expansion, contraction, and changes of "mix."

Long-Range Planning

The Bureau of Vocational Education, Maine State Department of Education must submit annually to the Office of Education a long-range plan. Since current programs constitute the realization of the long-range plan, the plan is central to both the decision-making and the funding processes.

Planning Requirements

The Office of Education requires, among other things, that the state's long-range plan

(1) extend over a five-year period beginning with the fiscal year for which the plan is submitted,
(2) describe the present and projected vocational education needs of the state, and
(3) set forth a program of vocational education objectives which affords satisfactory assurance of substantial progress toward meeting the vocational educational needs of the potential students in the State.*

The Office of Education also requires that the State Board (i.e., the Bureau of Vocational Education) enter into "cooperative arrangements" with the public employment service system of the State and that under such cooperative arrangements

> The employment offices will make available to the State Board and local educational agencies occupational information regarding reasonable present and future prospects of employment in the community and elsewhere. The State plan shall provide how such information, along with all other pertinent information available, will be considered by the State Board or local educational agencies in providing vocational guidance and counseling to students and prospective students and in determining the occupations for which persons are to be trained, and in providing such training.**

In addition, the Office of Education requires that the planning document

(1) shall describe in detail the method by which the State Board will give due consideration to "...information regarding current and projected manpower needs and job opportunities, particularly new and emerging manpower needs and opportunities on the local, state, and national levels."

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*Bureau of Adult, Vocational, and Library Programs, U.S. Office of Education, Regulations for State Plan Programs (April, 1969), pp. 47-48.

**Ibid., pp. 54-55.

(2) show "...how the State Board will identify current and projected manpower needs and job opportunities, particularly new and emerging needs and opportunities, on the local, state, and national levels."
(3) explain what "...use will be made of information obtained through cooperative arrangements..." with the Maine Employment Security Commission.
(4) explain "...what other information will be relied upon in identifying manpower needs and job opportunities, how it will be obtained, and how often it will be updated.*

Appropriateness of the Investment Approach

The current Maine State Plan for Vocational Education interprets "manpower needs" to mean the projected requirements of industry within the state for persons possessing particular skills.** This interpretation is reflected in the inclusion of projected job openings in the long-range plan document. The "vocational education needs of the potential students in the state" are not currently weighed as explicitly in the planning document as projected manpower requirements, although they may be implicit in the actual program plans from which it derives.

As noted above, however, the investment approach not only indicates which occupational skills are in relatively short supply, but also has the advantage of specifying which occupations yield the highest net return to the joint investment of society and the student. In this sense, the investment approach corresponds with Office of Education planning requirements.

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*Ibid., pp. 68-70.

**Maine Department of Education, The Maine State Plan for Vocational Education, 1971, Part 2, Long Range Plan Provisions, pp. 94-96.

Implementation in Long-Range Planning

From the point of view of the vocational education decision-maker, the long run is that period of time which is long enough so that all program inputs become variable. That is, it is possible in the long run to expand not only the number of students participating in a given program or programs, but also the size and nature of physical plant and equipment in those programs.

The long-range plan must specify the proposed composition of vocational-technical training programs in the fifth year hence. Determining that composition by using the investment approach would require the following steps:

(1) determining the average cost per student trained in each of the program options available, including estimates of foregone earnings and expenses undertaken by the student.

(2) conducting surveys having the characteristics emphasized in Section V, above, in order to determine the age-income profiles appropriate to each job category in which training may be undertaken.

(3) obtaining, perhaps through the facilities of the Maine Employment Security Commission, information on current starting wages for each occupation in which training may be implemented.*

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*Estimates of age-income profiles would be up-dated periodically--perhaps every five years--and starting wage data would be collected annually.

(4) projecting lifetime earnings on the basis of current wages and estimated age-income profiles.*

(5) discounting projected incomes to the present.

(6) calculating for each program option the ratio of discounted benefits per student to average cost per student.

(7) finally, ranking programs in decreasing order of the size of benefit-cost ratios.

The long-range plan would consist of projected implementation of changes in current program mix. More specifically, step (7) above provides the planning official with information relating the relative effectiveness of each program in meeting the objectives of the vocational-technical training programs. Since some programs will show relatively high benefit-cost ratios and others relatively low (perhaps fractional) benefit-cost ratios, the direction of program expansion and contraction is immediately indicated. That is, the information implies that the current mix of programs should be altered in such a way as to contract those programs with relatively low benefit-cost ratios and expand those programs with relatively high benefit-cost ratios. The long-range program mix would result from the successive annual alterations projected from information currently available.

Limits to Individual Program Expansion

Marginal changes in current program mix definitely imply expansion of that program with the highest benefit-cost ratio.

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*See footnote * on p. 40.

However, the question arises as to whether other programs which also have relatively high benefit-cost ratios should, themselves, be expanded. As noted above, under idealized circumstances training in one occupation would take place until the supply of persons so trained increased to the point where the long run rate of return fell back to normal. However, the flow into the market of persons trained by local vocational education agencies is not likely to be great enough to appreciably influence wages in a given occupation, and, therefore, the normal mechanism by which the value of training in the occupation having the highest estimated cost-benefit ratio falls (because of increased supply) will not necessarily function. However, there are at least two reasons why the value of training in the highest ranked occupation may fall below that of the next highest.

First, students, in choosing occupations, take into consideration costs and benefits which cannot be measured in money terms. Males would not be likely to choose nursing as a potential career even though nursing may be ranked highest in value measured in money terms. In general, students will not be indifferent between two programs with the same value. The tendency for students to prefer one occupation to another with the same benefit-cost ratio will be aggravated to the extent that the students' share of the cost of training differs between programs. For these reasons and others, then, the number of students demanding certain types of training must be considered in determining

relative program size. Hence, as a practical matter, the program or programs with the highest benefit-cost ratios should be expanded up to the limit of student demand. It appears that the extent of student demand could only be projected from past experience. At the same time, student awareness of the relatively high value of a given type of training (i.e., through dispersal of planning information) should help to stimulate student demand for that type of training.

Another limitation on program size may be the unwillingness of students to go out of state for employment after training. A student may calculate that the higher benefits stream associated with a given program may not be sufficient to induce him to give up personal ties and the advantages he perceives of living in Maine. Thus, indirectly through student demand the availability of jobs within the state becomes somewhat of a limitation on program expansion. In the extreme, if no job openings appear to be forthcoming in the near future in the occupation with the highest benefit-cost ratio within the State of Maine and at the same time, no student expresses a willingness to move out of state, that program should not be expanded.

In practice, an intermediate situation will probably be typical. The program with the highest benefit-cost ratio should be expanded to accomodate all qualified students who express an interest or who, on the basis of experience, are anticipated to do so. Then the program with the next highest benefit-cost

ratio is budgeted for expansion in the same way, and so on until the projected budget is exhausted.

Program Evaluation

The investment approach is particularly useful in program evaluation. The steps required to implement the investment approach in program evaluation are essentially the same as those enumerated above for long-range planning. The prime desideratum of program evaluation is, however, the elimination or phasing out of low-priority programs. Again, current programs with the lowest benefit-cost ratios should make way for programs which yield a higher return to students. In terms of the priority budgeting procedure used above, the bottom end of the benefit-cost ranking can be viewed as the area where program contraction takes place in order to preserve budget flexibility for expansion elsewhere.

A Caveat

It should be emphasized that the net monetary benefit criterion used in the investment approach may be used only when the programs being compared are homogeneous with respect to the target groups for which they are designed. That is to say, training programs for the culturally disadvantaged should not be contracted because their benefit-cost ratios compare unfavorably with those of secondary and post-secondary vocational training programs. Target groups and program goals differ too radically to make such comparisons valid.

Appendix A

LIMITATIONS OF THE MANPOWER REQUIREMENTS APPROACH

This approach is commonly called the "manpower needs" or "manpower requirements" approach and is frequently used as a basis for educational, especially vocational and technical education planning. Since the investment approach used in this study differs in considerable respect from the manpower requirements approach, it is only fair to state what the manpower requirements approach is, the difficulties with it, and the reasons why we have chosen to investigate the feasibility of the alternative investment approach for the State of Maine. Most of the experience with the manpower requirements approach has been gained by the Organization for Economic Cooperation and Development in six Mediterranean countries.* Consequently, much of the discussion which follows is derived from OECD experience though the peculiar difficulties (conceptual and empirical) of adapting the approach to the State of Maine will also be brought out.

Basically, the manpower requirements approach attempts to estimate the number of job openings which will become available in the economy over the length of the plan period, say, five

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*See Planning Education for Economic and Social Development, Organization for Economic Cooperation and Development (Paris, 1963).

years. These estimates are made in the following way:*

(1) The growth of each industry in the economy is predicted for the next five years. This is usually done by a linear extrapolation of recent experience. In other words, the approach assumes each industry will continue to grow (or decline) at the same rate observed in recent years.

(2) Estimates of the employment by each industry of the various occupations relevant to the educational plan are made for the last year of the plan period. These estimates depend upon (a) the amount of growth in each industry, and (b) the amount of technological change and its impact upon the relative rate of employment of each occupation in each industry.

(3) Estimates of the number of people currently employed in each occupation in each industry who will (a) retire, (b) die, (c) change occupations, (d) leave the planning area, and (e) leave the work force within five years are made. These estimates are based on the current sex, age and occupation distribution for each industry.

(4) The numbers calculated in (3) are then subtracted from the appropriate numbers of people currently employed in each industry and occupation.

(5) The results of this calculation are, in turn, subtracted from the estimated employment by occupation by industry

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*David Clark, Maine's Occupational Needs to 1975, Manpower Research Project, University of Maine, Orono, Maine, 1969, pp. 3-9.

five years hence. The result is the estimated number of job openings in each occupation in each industry which will occur between now and five years from now. These figures are the ones which are given to the educational planner as the quotas he must fill.

Though the approach seems rather straight-forward there are several pitfalls. The first and most obvious is the need to predict the rate of growth for each industry in the economy. The reliability of such predictions, no matter how carefully made, is notoriously low. There is no reason to suspect that when these predictions are made for the purposes of educational planning they will be any more reliable.* Secondly, prediction of the effects of technological change often presents the estimator with the need for a good stomach for heroic assumptions, though when one considers a period of time as short as five years there is perhaps not much room for gross errors.** Thirdly, estimates of retirements, deaths, changes in occupation, etc., require a great deal of data not always available or reliable.***

Applications of the approach to the Maine economy present special difficulties in addition to these. On the data side the difficulty with industry growth projections is readily apparent.

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*See, for example, R. Hollister, "A Technical Evaluation of the Mediterranean Regional Project," Monthly Labor Review, March 1964.

**Ibid.

***Clark, op. cit.

For example, an oil refinery at Machiasport (or Searsport), a ship contract for Bath Iron Works, a change (up or down) in the shoe or textile tariffs, or a phasing out or locating of any reasonably sized industrial plant--all possibilities for the Maine economy and all subject to a great deal of uncertainty--would have significant and relatively unpredictable impacts on the estimated manpower requirements for the State over a five year period.

Another data problem concerns the availability of sufficiently detailed data relating to occupational requirements in each industry. The precision of this data needs to be such that it is possible for the educational planner to distinguish between, for example, the great variety of machinists which exist in industry. If the data do not make these fine distinctions, the results of the manpower requirements approach are not translatable into usable planning estimates. Data of the necessary precision do not exist for the current situation, let alone for five years hence. Generation of such data for the State would be extremely expensive.

Even assuming away these problems, however, the fact that Maine is an "open economy" (i.e. its borders are open to trade and migration) presents further difficulties. For example, in an open economy a manpower requirements estimate for each occupation (assuming that this could be done in the first place) would also have to take into account the number of in- and out-migrants

in each occupational category. An underestimate of the number of in-migrants would result in the "over-production" of Vocational-Technical Institute graduates. How such estimates could be reliably made in the first place is a moot question.

An "open economy" also introduces into the planning process the need to time rather well the graduation of Vocational-Technical Institute students and the appearance of the jobs for which they were trained. If, for example, there is expected to be a need for X number of electronics technicians by the end of the plan period, it is necessary that these graduates have X jobs waiting for them or promised for the near future or they will have no choice but to seek employment out of the State. On the other hand, if an industry needs electronics technicians at one point in time but none are expected to leave the Vocational-Technical Institutes in the near future they are quite likely to go out of State for the required skilled manpower. Scheduling difficulties arising for either of these reasons are likely to reduce the potential effectiveness of Vocational-Technical Institute training. These problems will occur no matter what kind of training is undertaken but are likely to be especially troublesome under a planning regimen geared to specific job openings.

Finally, perhaps the most glaring drawback of the manpower requirements approach is that it does not take into account the costs and benefits of any particular plan. That is, even though it does finally produce a quota for each occupation it does not ask whether or not fulfillment of that quota will be socially

beneficial or for that matter, beneficial to the students trained. From the point of view of efficient and socially useful planning, this drawback is extremely serious for it creates the very real possibility of providing expensive training in areas where the benefits to students and society are very small.

Appendix B

QUESTIONNAIRE

Maine State Department of Education
Bureau of Vocational Education

and

The Manpower Research
Project of the University of Maine

PILOT STUDY ON THE ECONOMIC BENEFIT OF VOCATIONAL EDUCATION

Answers to all questions will
be kept in strictest confidence

June, 1970

PART I THESE ARE QUESTIONS ABOUT YOUR CURRENT JOB

Sex_____

1. How old are you?

Employer_____

2. Are you married? ____yes____no

_____

If yes, how long?_____

Location_____
city

Is your spouse working?__yes__no

_____
state

If yes,

Occupation?_____

Length of employment?_____

3. Have you ever turned down a job because your wife would have to give up her work? _____yes_____no

4. How many children do you have?_____Ages_____ _____ _____ _____

5. What is the last grade you completed in school?_____

6. Have you ever had any training in a special school of any sort?

____yes____no

If yes, what type of training?_____

How long was the training?_____

7. Did this training relate to your current occupation?___yes___no.

If no, what was the training in?_____

8. What is your job title?_____

9. Is this a full-time___or part-time___job?

10. Do you have two jobs___yes___no? (If yes, fill out Part II for other job and note it as such.)

11. How long have you worked for this employer?_____

12. How did you learn the skills for this job? (Rank importance; 1,2,3,4,etc.)

___high school
___college
___technical school
___picked it up before getting this job
___military
___learned it in a training program sponsored by___ your present employer ___other employer
___picked it up on the job___ with this employer___with other employer
___other (specify)_____

13. What is your annual (before tax) income on this job?_____ (can be approximate)

___under 2,000
___2,000-2,999
___3,000-3,999
___4,000-4,999
___5,000-5,999
___6,000-6,999
___7,000-7,999
___8,000-8,999
___9,000-9,999
___10,000-14,999
___over 15,000
___cannot estimate

14. If you cannot estimate your annual income:

a. What is your hourly_____or weekly_____wage? If weekly, is it take-home?___yes___no

b. How many hours per week do you work on this job on the average?_____

15. Would you describe your job briefly?

16. What are the machines or tools you work with most frequently?

a._____ c._____ e._____

b._____ d._____ f._____

17. We would like you to describe your job in terms of its relationship to other people, to machines and to data.*

People_____ Data_____ Things_____

18. How long have you done this work?_____

19. Have you ever done any other kind of work for this employer?
_____yes_____no

_____

*Response categories appear on pp. 58-9.

20. Did you change your residence when you took this job?
_____yes _____no

21. How long were you unemployed between this job and your previous job?_____

PART II THESE ARE QUESTIONS ABOUT YOUR PAST JOBS

22. We are interested in the types of full-time jobs a person holds during his work years. We would like to have the same information about your past jobs as you have given us for your current job. (most recent job here)

a. Title_____ b. Income_____

c. What are the machines or tools you work with most frequently?

1. _____ 3. _____ 5. _____

2. _____ 4. _____ 6. _____

d. Length of time with this employer_____

e. Length of time on this job_____

f. Employer_____

g. Location_____
City State

h. Is this a second job you currently hold?___yes___no

i. Relationship to: People_____ Data_____ Things_____

j. Training

____high school
____college
____technical school
____picked it up before getting this job
____military
____learned it in a training program sponsored by___your present employer___other employer
____picked it up on the job____ with this employer___with another employer
____other (specify)_____

k. Why did you leave this job?_____

1. Did you have any training between the time you left this job and started the next?_____

   If so, where?_____

   What king of training?_____

   How long did it take?_____

m. Did you change your residence when you took this job?
___yes ____no

23. (Next most recent job)

a. Title_____ b. Income_____

c. What are the machines or tools you work with most frequently?

1. _____ 3. _____ 5. _____

2. _____ 4. _____ 6. _____

d. Length of time with this employer_____

e. Length of time on this job_____

f. Employer_____

g. Location_____
City State

h. Is this a second job you currently hold?____yes____no

i. Relationship to: People_____ Data_____ Things_____

j. Training

____high school
____college
____technical school
____picked it up before getting this job
____military

____learned it in a training program sponsored by____
your present employer____
other employer
____picked it up on the job
____with this employer
____with another employer
____other (specify)_____

k. Why did you leave this job?_____

1. Did you have any training between the time you left this job and started the next?_____

   If so, where?_____

   What king of training?_____

   How long did it take?_____

m. Did you change your residence when you took this job?
   ____yes____no

24. (Next most recent job)

a. Title_____ b. Income_____

c. What are the machines or tools you work with most frequently?

1. _____ 3. _____ 5. _____

2. _____ 4. _____ 6. _____

d. Length of time with this employer_____

e. Length of time on this job_____

f. Employer_____

g. Location_____
City State

h. Is this a second job you currently hold?____yes____no

i. Relationship to: People_____ Data_____ Things_____

j. Training

____high school
____college
____technical school
____picked it up before getting this job
____military
____learned it in a training program sponsored by____
your present employer____
other employer
____picked it up on the job____
with this employer_____
with another employer
____other (specify)_____

k. Why did you leave this job?_____

1. Did you have any training between the time you left this job and started the next?_____

   If so, where?_____

   What king of training?_____

   How long did it take?_____

m. Did you change your residence when you took this job?
   ____yes____no

25. (Next most recent job)

a. Title_____ b. Income_____

c. What are the machines or tools you work with most frequently?

1. _____ 3. _____ 5. _____

2. _____ 4. _____ 6. _____

d. Length of time with this employer_____

e. Length of time on this job_____

f. Employer_____

g. Location_____
City State

h. Is this a second job you currently hold?____yes____no

i. Relationship to: People_____ Data_____ Things_____

j. Training

____high school
____college
____technical school
____picked it up before getting this job
____military

____learned it in a training program sponsored by____
your present employer
____other employer
____picked it up on the job
____with this employer
____with other employer
____other (specify)_____

k. Why did you leave this job?_____

1. Did you have any training between the time you left this job and started the next?_____

   If so, where?_____

   What kind of training_____

   How long did it take?_____

m. Did you change your residence when you took this job?
   ____yes____no

PEOPLE

0 The job involved helping people with legal, medical, spiritual, or other problems which require professional advice.

1 The job involves making decisions about production, programs, or employment policies for some future date.

2 The job involves teaching or training people.

3 The job involves scheduling, supervising or directing the work of a group of employees.

4 The job involves entertaining others.

5 The job involves selling people a service or product.

6 The job involves talking with and/or signaling people to convey or exchange information.

7 The job involves serving or caring for people.

8 No relationship.

THINGS

0 The job involves setting up, adjusting, making and replacing parts of machines.

1 The job involves choosing materials and tools and then constructing an object using these tools.

2 The job involves starting, stopping, controlling and adjusting equipment or machines.

3 The job involves driving or operating a vehicle.

4 The job involves working upon or moving material with some choice of tools and the amount of precision necessary.

5 The job involves watching gauges or lights and then making adjustments if the machine is not working properly.

6 The job involves putting objects into a machine, taking them out and throwing away any waste material.

7 The job involves working upon or moving material from one place to another by hand or with machines. (Not vehicles)

8 No relationship.

DATA

0 The job involves putting information together in order to discover facts or new knowledge.

1 The job involves organizing machines or people to work more efficiently.

2 The job involves studying information in order to reach conclusions or alternatives.

3 The job involves gathering information and data and classifying.

4 The job involves adding or calculating numbers.

5 The job involves making copies or duplicating originals.

6 The job involves comparing machines, data, or people.

7&8 The job does not involve work with data.

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